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"LAFAYETTE! WE ARE HERE"

BEN H. PETTY

Associate Professor of Highway Engineering, Purdue University

We at Purdue are hoping that the above title will be the rallying cry of several hundred members and friends of S. P. E. E. on the Purdue campus June 17–19, during the 39th Annual Convention. Our University, the cities of Lafayette and West Lafayette, and the state of Indiana feel highly honored by the opportunity of entertaining this large group of engineering educators and plan to prepare a real Hoosier welcome.

It is true that a great many of those attending these annual meetings still prefer the comfort and safety of railway travel. However, there is an annually increasing number who take to the numerous highway trails via the automobile and enjoy the more attractive scenery, greater freedom and numerous opportunities for stop-overs and side trips this method of transportation affords.

For this latter group some of the major Federal Highways, marked uniformly with the U. S. shield, leading towards Lafayette are listed as follows:

1. *From the North—*
   - (a) U. S. Road 41: from Eagle River on Lake Superior through Green Bay—Milwaukee—Chicago—intersecting 8 mi. S. of Kentland Indiana with U. S. Road 52 leading into Lafayette.
   - (b) U. S. Road 31: Mackinac City—Muskegon—South Bend—Rochester—thence by Indiana State Road 25 to Logansport—U. S. 24 to Reynolds—43 to Lafayette.
2. *From the Northeast—*
   - (a) U. S. Road 20: Boston—Albany—along south shore of Lake Erie to U. S. 24 S. of Toledo—Ft. Wayne—Reynolds—43 to Lafayette.
3. *From the East—*
   - (a) U. S. Road 30 (Yellowstone Trail): Philadelphia—Pittsburgh—Ft. Wayne—U. S. 24 to Reynolds—43 to Lafayette.
   - (b) U. S. Road 40 (old National Road): Atlantic City—Baltimore—Wheeling—Columbus—Indianapolis—U. S. 52 to Lafayette.

(*c*) U. S. Road 50: Annapolis—Washington—Grafton, W. Va. —Chillicothe, O.—Cincinnati—U. S. 52 to Lafayette.

4. *From the Southeast—*

(*a*) U. S. Road 60: Cape Henry—Richmond—Charleston—Louisville—U. S. 31 to Indianapolis—U. S. 52 to Lafayette.

(*b*) U. S. Road 25: Augusta—Asheville—Knoxville—Cincinnati—U. S. 52 to Lafayette.

(*c*) U. S. Road 41: Miami—Atlanta—Nashville—Evansville—Boswell, Ind.—22 to Templeton—U. S. 52 to Lafayette.

5. *From the South—*

(*a*) U. S. Road 31: Mobile—Montgomery—Nashville—Louisville—Indianapolis—U. S. 52 to Lafayette.

(*b*) U. S. Road 51: New Orleans—Jackson—Memphis—Cairo —Vandalia, Ill.—U. S. 40 to Indianapolis—U. S. 52 to Lafayette.

6. *From the Southwest—*

(*a*) U. S. Road 80: San Diego—Phoenix—El Paso—Dallas—U. S. 67 to Little Rock—St. Louis—U. S. 40 to Indianapolis—U. S. 52 to Lafayette.

(*b*) U. S. Road 66: Los Angeles—Flagstaff—Albuquerque—Amarillo—Oklahoma City—St. Louis—U. S. 40 to Indianapolis—U. S. 52 to Lafayette.

7. *From the West—*

(*a*) U. S. Road 40: San Francisco—Salt Lake City—Denver—Kansas City—St. Louis—Indianapolis—U. S. 52 to Lafayette.

8. *From the Northwest—*

(*a*) U. S. Road 10: Seattle—Missoula—Bismark—St. Paul—Appleton, Wis.—U. S. 41 to Chicago—to 8 mi. south of Kentland, Ind.—U. S. 52 to Lafayette.

(*b*) U. S. Road 20: Yellowstone Park—Casper—Sioux City—Dubuque—Chicago—U. S. 41 to 8 mi. south of Kentland, Ind.—U. S. 52 to Lafayette.

(*c*) U. S. Road 30: Portland—Boise—Cheyenne—Omaha—Chicago—U. S. 41 to 8 mi. south of Kentland, Ind.—U. S. 52 to Lafayette.

Since the Convention falls in the midst of the road building season, no doubt detours will be encountered on several of these routes. Information along this line should be secured locally.

Through the courtesy of the Indiana State Highway Commis-

sion we are in a position to send copies of our own state highway map to anyone upon request. Please address the Office of Dean A. A. Potter. These maps show type of surface on all Indiana state roads, also those county roads which are paved. The map also contains information relative to colleges and universities, state parks, and points of historical interest. Indiana prides itself on having more miles of roads "out of the mud," that is surfaced with gravel, stone or some higher type, than any other state.

In case anyone contemplates travelling via motor bus it may be of interest to know that the Greyhound Bus Lines operate from Chicago through Lafayette to Indianapolis. Connections are made with other transcontinental bus lines passing through these two terminals. Indianapolis boasts one of the largest bus terminals in the country.

For the information of those who expect to come by rail, Lafayette is served by the following steam railroads:

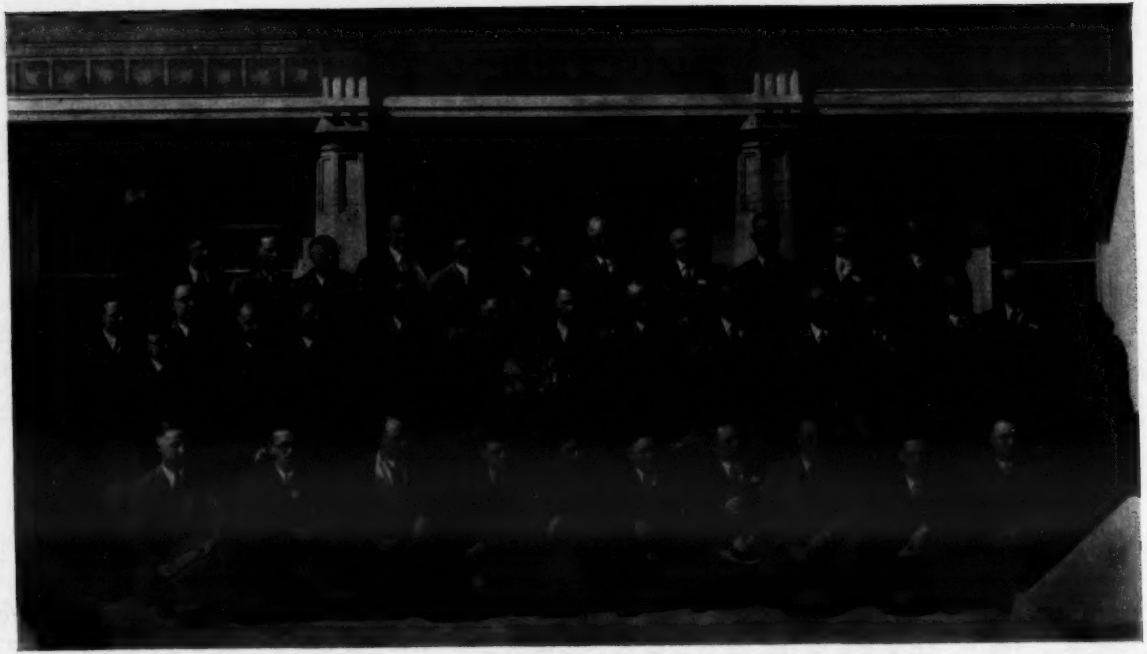
1. Big Four R. R.—Chicago through Indianapolis to Cincinnati.
2. Wabash R. R.—Detroit to St. Louis.
3. Monon R. R.—Chicago to Louisville.
4. Nickel Plate R. R.—Buffalo to Peoria.

Obviously it would be unwise to publish time schedules of arrivals at Lafayette as these are subject to change prior to the Convention time.

If any of those planning on attending this Convention are sufficiently air minded to take to the air, the following information relative to some of the more important lines may be of interest:

1. T. A. T.—Maddux Lines & Penna. R. R.:
   (*a*) New York—Columbus—Indianapolis.
   (*b*) Los Angeles—Albuquerque—Kansas City—Indianapolis.
2. Northwest Airways: St. Paul—Chicago.
3. Boeing System: San Francisco—Salt Lake City—Omaha—Chicago.
4. Western Air Express: San Francisco—Los Angeles—Albuquerque—Kansas City.
5. S. A. F. E. Way Air Lines: Dallas—St. Louis.
6. Embry Riddle Co.: Cincinnati—Indianapolis—Chicago.
7. Stout Air Lines: Cleveland—Toledo—Detroit—Chicago.

Located 150 miles southeast of Chicago and 65 miles northwest of Indianapolis, Purdue is very favorably situated insofar as being convenient to reach via either highway, railway or airway transportation.



ARKANSAS-OKLAHOMA SECTION, SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. In Session, Stillwater, Okla., February 14, 1931.

ARKANSAS—OKLAHOMA SECTION OF S. P. E. E.

HISTORICAL

During the fall of 1930 Dean W. N. Gladson of Arkansas University wrote to Dean P. S. Donnell of Oklahoma A. & M. and Dean J. H. Felgar of Oklahoma University suggesting the organization of a section of the S. P. E. E. The three Deans took the suggestion before their respective faculties and each faculty approved the idea.

Dean Donnell and his faculty immediately issued an invitation to the Oklahoma University and Arkansas University Engineering College faculties requesting that the organization meeting be held at Stillwater. This invitation was accepted and February 13 and 14 was set as the date.

The following was prepared under the direction of Dean Gladson:

Registration, Dean Donnell's office, Engineering Building.

February 13.

6:00 P.M.

Dinner. Tiger Tavern Annex, Campus.

Address of Welcome by Dr. Henry G. Bennett, President, Oklahoma A. & M. College.

Response by J. H. Felgar, Dean of Engineering, University of Oklahoma.

Introduction of guests by Deans.

7:30 P.M.

Business Meeting, Dean Phillip S. Donnell, presiding.

1. Organization.
   Election of officers.
   Appointment of committees.
2. Organization of an Electrical Engineering Laboratory, by E. R. Page, Prof. of E. E., University of Oklahoma.
   Discussion by W. B. Stelzner, Prof. of E. E., University of Arkansas; H. Naeter, Head of Dept. E. E., Oklahoma A. & M. College.
   General discussion.
3. The Responsibility of the Engineer for the Training of Men for Occupations in Industry on the Lower Levels, by Chas. W. Briles, Prof. of Industrial Education, Oklahoma A. & M.

Discussion by M. E. Farris, Prof. of M. E., University of Arkansas; J. H. Felgar, Dean of Engineering, University of Oklahoma.
General discussion.

4. Design and Construction Projects as Activities for Engineering Students, by L. C. Price, Research Asso. Prof. of M. E., University of Arkansas.
Discussion by V. L. Maleev, Research Prof. of M. E. Oklahoma A. & M. College; W. H. Carson, Prof. of M. E., University of Oklahoma.
General Discussion.

Auditorium, Old Central Building.

February 14.

8:30 A.M.

1. Instruction Methods in Mechanical Engineering Laboratory, by V. W. Young, Prof. of M. E., Oklahoma A. & M. College.
Discussion by J. T. Strate, Asst. Prof. M. E., University of Arkansas; E. F. Dawson, Asst. Prof. M. E., University of Oklahoma.
General discussion.

2. Some Phases in the Teaching of Mechanics, by J. C. Davis, Prof. and Head of Dept. of Mechanics, University of Oklahoma.
Discussion by R. L. Flanders, Oklahoma A. & M.; G. P. Stocker, Prof. of Civil Engineering, University of Arkansas.
General discussion.

3. S. P. E. E. Summer Schools for Engineering Teachers, by W. R. Spencer, Prof. C. E., University of Arkansas.
Discussion by J. F. Brookes, Prof. of C. E., Oklahoma A. & M. College; H. E. Flanders, Prof. of C. E., Oklahoma A. & M. College.
General discussion.
Report of committees.

11:30 A.M.

Visit to College buildings and grounds.

12:30 A.M.

Luncheon.

Adjournment.

An invitation was extended by the Oklahoma A. & M. faculty and their wives to the visiting faculties and their wives to be guests in their homes at Stillwater during the meeting. This invitation was pretty generally accepted and this generous hospitality added very much to the social atmosphere of the meeting.

The following officers were elected:

L. C. Price, Research Assoc. Prof. of M. E., University of Arkansas, President.

G. R. Saxton, Head of Dept. of C. E., Oklahoma A. & M., Vice-President.

J. F. Brookes, Prof. of C. E., University of Oklahoma, Vice-President.

W. R. Spencer, Prof. of C. E., University of Arkansas, Secretary.

THE RESPONSIBILITIES OF THE ENGINEER FOR THE TRAINING OF MEN FOR OCCUPATIONS IN INDUSTRY ON THE LOWER LEVELS *

By CHAS. W. BRILES

Professor of Industrial Education, Oklahoma A. and M. College

Society has undertaken, through a system of public education, to train each of its citizens for the responsibilities of citizenship and of workmanship. A complete system of public education, according to Plato, is "a ladder with one end in the gutter and the other in the university." If one should read only this statement from Plato's discussion in his Republic of the function of education the conclusion might be reached that this system of education might mean that everyone should start at the first rung of the ladder—the gutter, and continue to the last rung—the completion of a university course. A further study of his scheme of public education, however, reveals the fact that he has undertaken to establish a system which will prepare the citizens of the Republic to receive the maximum education of which they are capable so that they will efficiently function as citizens and as workers on whatever levels their abilities might indicate. By a series of tests during the period of training the level of one's responsibility and activity is determined. At different points along the way they drop out of formal training and go to work, some remain in training to the age of thirty-five. Those who have survived the suceeding series of tests up to this point are then required to spend fifteen years at work. Then those who survive, scarred and fifty, sober and self-reliant, shorn of scholastic vanity by the merciless friction of life, and armed now with all the wisdom that tradition and experience, culture and conflict, can coöperate to give—these men, at last shall automatically become the rulers of the state.

Since the days of Plato educators, statesmen, and economists have been trying to devise a scheme of education which would afford equal opportunity for every citizen to enter the race of life without the handicap due to the lack of instruction and training.

Abraham Lincoln, who was perhaps the best educated man that this nation has produced, when he was about to sign the Morrill Act which resulted in the establishment of an institution in each state,

* Presented at the organization meeting of the Arkansas-Oklahoma Section, S. P. E. E., February 13–14, 1931.

with Federal grants of land and money for the purpose of giving instruction in agriculture and mechanic arts, made this observation: "Educated people must labor. Otherwise, education itself would become a positive and intolerable evil. No country can sustain in idleness more than a small percentage of its numbers. The great majority must labor at something productive. From these premises the problem springs: 'How can labor and education be most satisfactorily combined?'" Engineering schools are seeking to find a practical and workable plan for the solution of the problem of the combination of theory and practice. An engineering school maintains shops courses in pattern-making, forge and foundry, and machine shop work. The engineering students who take these shops courses receive instruction and training which results in the development of judgments and skills up to the point of appreciation of the relation of such operations to the job of the engineer. It is hardly possible, and it is certainly not expected, that these courses result in the development of doing ability in any of these fields. A further effort to relate work and study properly, education and labor, or theory and practice, is found in some requirement of practically all engineering schools that, before an engineering degree may be granted, a certain amount of industrial experience, evidenced by summer employment, must be secured. Sometimes the type of experience which one secures in order to meet the requirements for graduation does not very closely relate to the work for which he is being trained in his college course. Nevertheless, it is generally held by those interested in the promotion of engineering education that industrial experience, though not closely related to the subject matter of the college course, has some value.

A further effort to more closely relate theory and practice is a requirement that each applicant for a degree in engineering make a tour, sometime during his senior year, for the purpose of visiting industrial plants and getting some notion of types of organization, methods of procedure, standard processes and operations, and general working conditions of some of our leading industries.

I am convinced that one would be justified in the statement that schools of engineering have not fully met the challenge of Abraham Lincoln in the development of workable plans for a satisfactory combination of labor and education. This fact is more fully recognized by the employers of engineering graduates than by those who train engineers. For the past twelve years I have had opportunity to make contacts with employers of labor in industry from the level of the roustabout to that of the general manager. It has been interesting even during this relatively short period of time to observe the evolution of the attitude of the employers toward the engineer. Not long ago the independent oil producer gave little

consideration to expert information of the geologist. I recall that one of our leading geologists in 1918 was invited to address the Redlands Club of the A. & M. College and in that address he stated, with considerable emphasis, that no oil could be produced in regions where the redbeds appear. This information, however, did not deter some of our somewhat reckless wildcatters from seeking to develop gushers in such regions, and the theories of the geologist have been disproven by the fact that the drill bit has gone through the redbeds to producing sands below. Despite this fact, however, the oil producing industry has come so fully to recognize and appreciate the value of science in relation to oil production that you could not get a bid on a lease anywhere unless you have, or there is available, a geology report upon the area in question.

More and more leaders of industry are coming to recognize the value of science and skills in the further development of processes and operations involved in production. A complete solution of the problem lies in a further development of plans of coöperation between employers of labor in industry and the recognized training agencies.

In the development of an adequate plan of coöperation there are certain factors which must be taken into account. These factors apply with equal force to the training of men on the college level or the high school level. They include the following:

1. The training environment should be the same as the working environment.

2. The training jobs should be carried on in the same way as in the occupation itself.

3. The trainee should be trained specifically in manipulative habits and thinking habits required in the occupation itself.

4. Adequate repetitive training in experiences from the occupation fixes habits of doing and of thinking to a degree necessary for employment.

5. The instructor should be master of the knowledge and skills he teaches.

6. Training should be given on actual jobs and not on exercises or pseudo-jobs.

If this list of factors is recognized as applying to an adequate training program on the college level, it becomes apparent at once that there is necessity for a complete scheme of coöperation between productive industry and the engineering school.

But what has all this to do with the responsibility of the engineer for the training of workers on the lower levels? The engineer finds his place in productive industry, as a research worker, as a manager, or as a worker. As a research worker he is responsible for the development of new processes and operations, the applica-

tion and use of which, involves the training of workers in manipulative skill and thinking habits. As a manager he is directly responsible to his organization for the formulation of plans and policies for the training of new workers for old jobs or for the training of old workers for new jobs.

The apprenticeship system of training workers in productive industry no longer meets the needs of modern industrial organizations. This system was never effective except for the training of workers in highly skilled trades.

Perhaps the most important and far reaching provision of the Federal Act for Vocational Education is found in Section 11 of the Vocational Education Act and reads as follows: "At least one-third of the sum appropriated to any state for the salaries of trade, home economics, and industrial subjects shall, if expended, be applied to part-time schools or classes for workers over fourteen years of age who have entered upon employment, and such subjects in a part-time school or class may mean any subject given to enlarge the civic or vocational intelligence of such workers." This provision has made it necessary for those in each state charged with the responsibility of promoting vocational training courses in trades and industries to develop a plan of coöperation between industry and the school. It will be observed from the language of this provision that the two major functions of public education are specifically mentioned "any subject matter which relates either to civic or vocational intelligence" may be given and paid for from Federal funds. The public school of any community has just two major functions, the preparation of the future citizens and workers for responsibilities of citizenship and of workmanship, the development of abilities which will enable one to live and to make a living. In a democracy we recognize, theoretically, the principle of equality of opportunity in matters of education, but while we provide, at public expense, opportunities for the engineer to receive his instruction and training, in an institution supported and maintained by the state at public expense, we do not provide at public expense for the training of workers on the lower levels. This is due to the fact that it is impossible for a high school to equip itself with training facilities in the great variety of occupations which the community affords. Any adequate program of instruction and training for those engaged in productive industry must recognize the necessity for a complete scheme of coöperation between the employer and the school. In the school, instruction is given in related subject matter, science, drawing, and mathematics, and in the shop or the factory, under the direction of the foreman, training is given in the development of skills.

From the standpoint of industry an individual is being trained

so that he may become a more productive workman. From the standpoint of society the individual is being trained so that he may become an economically independent member of the social group. Society is interested, too, in the development of occupational efficiency for the reason that in the last analysis the consumer pays for all inefficiencies in work. This principle can be illustrated nowhere better than the automobile repair and service work which today practically every citizen requires. My car refuses to perform. By some means or other I get it into a garage. I state the symptoms of the case as accurately as possible. The mechanic makes an examination and tinkers with the carburetor, whereupon I pay him for service which he is supposed to have rendered. It soon develops that the car is in worse shape than it was before. I return or go to another garage. You know the rest of the story. You have all had similar experiences, due to the fact that men have not been properly trained and not, as we sometimes suppose, that they do not want to render good service. A four year course in auto mechanics with half time in school given to related subject matter and citizenship courses and half time to work under the supervision and direction of a skilled foreman is, without question, the best procedure for the training of a skilled mechanic and the development of a useful member of society.

And, again, you may ask what has this to do with the responsibilities of the engineer. The engineer is the technical expert in an industrial organization. The engineer is the contact man with the public schools. The school man does not know the job specifications in any industrial organization. He sometimes has little idea of the subject matter relating to any given industry. Superintendent Walter Isle of Ponca City has little conception of the job specifications of the various and sundry jobs listed on the payroll of the Empire and Continental Refineries of that city. Walter Miller, superintendent of the Continental Refinery Company, knows what each man has to do and what each one must know. The engineers in the several divisions of the Continental Refining Company make contact with Fred Heissler, the local supervisor of vocational education, and a course of study is agreed upon which will function in the training of men in the various occupations of that industry. Without the assistance of the engineer and without an intelligent conception of his duties and responsibilities in this field the schools and the industries cannot coöperate in such a manner as to best serve in the training of the youth for the responsibilities both of citizenship and of occupation.

At the beginning of the last school year I was asked by the manager of the Southwestern Light and Power Company, a subsidiary of the Insul Corporation, to assist in the development of a

program of instruction and training which would meet the needs of the men employed in that industry. I agreed to conduct a foremanship training conference with groups of company foremen at Chickasha and Lawton, two days a week at Chichasha, and two days a week at Lawton. This program continued during the year.

Mr. Bernard Lowe, the engineer of Chickasha Division, was a member of the group at Chickasha, and Mr. Fred Huckleby, engineer of the Lawton Division, was a member of the group at Lawton. Mr. Lowe had completed one half of his junior year in electrical engineering at Oklahoma A. & M. College and Mr. Huckleby is a graduate in electrical engineering from the University of Oklahoma. Through the coöperation of these two men and others of the group we were able to develop subject matter in electricity adapted to the needs of those working on the lower levels in the electrical industry. The public schools of Lawton and Chickasha coöperated with the industry in financing instruction through evening classes for those engaged in those occupations, and Mr. Lowe and Mr. Huckleby were the teachers of the groups.

The State Department of Vocational Education published a bulletin giving in outline the subject matter for these groups, and this bulletin has been adopted by the Insul Properties in the electrical industry as a basis for instruction and training of those engaged in electrical trades in that industry.

Mr. Lowe now has leave of absence from his job at Chickasha and is enrolled again in the college where he will complete the work for his degree in electrical engineering. Upon the completion of his course at the college he will then be assigned to an institution in Chicago were employees of the Insul Properties are given further instruction in the application of principles which they have learned in their college course.

It will take time to develop fully workable plans of coöperation between industry and schools both on the college level and on the high school level.

If the theory that the best training is given in the occupational environment and under the occupational working conditions is to be most effectively met, this training should, whenever possible, be given in the occupation itself. This type of school is based upon the proposition that the shop experiences of the students should be obtained in the occupation for which they are being trained and that the other parts of the program should be given in the school. Such a scheme of coöperative education on the high school level is similar to that which was originated by Dean Schneider of the University of Cincinnati.

The lack of coöperation between industry and the schools results in a tremendous economic waste. Perhaps the most conclusive evi-

dence of this statement is the fact that millions of American workmen have turned to the correspondence school for assistance. For a period of the first thirty years of its existence which closed only recently, one correspondence school alone reports a total business of $175,000,000, virtually all of which represents tuition fees from individual students seeking vocational instruction, most of which is for occupations and pursuits in which they were already engaged. This huge sum would maintain a typical American University for about forty years. All of this sum was paid out of the pockets of ambitious, struggling wage-earners, because of the failure of industry and the school to serve their needs adequately. This, too, in a country where we boast that education is democratic. In the year 1922, alone, three correspondence schools collected a total of more than $25,000,000 in tuition fees. Assuming an average payment of $40.00 by each student enrolled, which is a liberal estimate, these three schools enrolled, for the one year, alone, more than six hundred thousand students, a group almost as large as the total number of students registered that year in all of our higher institutions of learning.

Leaders of industry are ready to meet the leaders in fields of education in the development of a system of coöperative training which will meet the needs of every individual, whether on the high school level or the college level. In the development of this program the engineer, the technical expert in the field of productive industry, will play a most important part.

DESIGN AND CONSTRUCTION PROJECTS AS ACTIVITIES FOR ENGINEERING STUDENTS *

By L. C. PRICE

Mechanical Research Engineer, University of Arkansas

Introduction

The instinct to "belong," and the instinct to "do something," are among the oldest and most deeply rooted of all human tendencies. The small boy may profess to hate his school, and to hate to study, and to hate his teacher, yet—at heart—he is loyal to that group with whom his lot is cast, and is ready to defend it and its doings, both verbally and physically, against any stranger who may have the temerity to deprecate either. Within the school and within the neighborhood, boys of similar tastes often form small groups, or clubs, occasionally with the simple incentive afforded by congeniality, but more often with the object of "doing something." Typical of these is the Little Scorpions' Club of the Toonerville boys, in the Sunday comics. One of the strongest arguments in favor of the Boy Scout movement is the fact that boys are bound to be doing something, on their own initiative. Proper guidance can direct their activities into useful channels. Lacking such an outlet for their energies, it is extremely likely that they will band together for purposes useless, if not actually vicious. This instinct for organization and for "doing something" persists throughout life.

So the engineering student in college is not likely to be satisfied simply to study his lessons and recite them in class. His scheduled work must be heavy indeed if he is unable to find some spare time in which to do as he pleases. It is extremely doubtful if this condition ever exists or if it would be a good thing if it did. However small may be the amount of spare time the student is able to squeeze from his scholastic duties, if he has any initiative or is at all worth while, he will somehow find enough time to enable him to belong to an organization or two, and to engage in some sort of outside activity. Industrial executives know this, and in hiring engineering graduates, will usually give preference to those men who have either worked their way through school, or have been active in student organizations, or have proved their independence

* Presented at the organization meeting of the Arkansas-Oklahoma Section, S. P. E. E., February 13–14, 1931.

in some other way. The plodder who has done no more than what he was told to do, must have made grades far above the average if he is to receive much consideration.

Activities Open to Engineering Students

Many forms of activity present themselves as candidates for the student's attention. We will here consider a few of those in which the engineering student may engage.

First, his financial state may be such that he must work in order to support himself while in college. In that case, he will have little time to devote to the non-essentials, and the very fact that he persists in going to college under such a condition is pretty good proof of his courage and industry. Such men may not make the highest possible grades while in college, due to the demands on their time, but it has been my observation that those who are able to finish are above the average, both in scholarship and as all-around men.

Not all students do, or can, go out for athletics, but for those who do, this activity is probably next to self-support in order of importance. It is not the purpose of this paper to discuss the merits, or otherwise, of intercollegiate athletics, but it is generally admitted that the training in leadership and coöperation is of value to those who take part. It is often argued that athletics take too much of the student's time from his studies, and this is undoubtedly true in some cases. Almost all of us, however, know of athletes who have made exceptional grades and have had scholastic honors bestowed upon them. Dramatics, debating, and journalistic work are among the many other activities in which students may engage.

Student branches of the professional engineering societies offer one of the most valuable outlets for students of engineering. In this work the student gets training in leadership and in writing and public speaking, a better perspective of the field for which he is fitting himself, acquaintance with current literature in his chosen field, closer contact with his teachers, and last, but by no means least, an acquaintance either personally or by reputation, with the highest type of men in his profession. An engineering graduate who is able to point to a record of activity in his professional society has, in that fact, a valuable recommendation to prospective employers. A graduate who has not been a member of one of these societies is almost sure to be regarded with the suspicion that there must be something wrong.

Journalistic work in general has already been referred to. Nearly every engineering college has its journal of engineering, edited and published by students, and many of the articles in these

journals are written by students. Work on the staff of such a publication constitutes one of the most profitable of activities for the engineering student.

The Need for Creative Work

In addition to his interest in all the professional and other activities which have been mentioned, nearly every born engineer has a natural desire to design something or to make something. If he can turn out a design or a machine that he can truly call his own, or if his group can produce something truly their own, the work arouses an interest, and the completion of it a satisfaction, which are seldom produced by other forms of activity.

Of course, there are construction problems and design problems in every engineering course. It is seldom, however, that any such design ever exists except on paper, or that the ordinary shop exercises are ever such that the student can see the parts fitted together into a finished machine. There is danger, therefore, that the end toward which the student strives may be not so much to design or make a good machine, as to please his instructor. Of course, this is not always so, and may not apply in even a majority of cases, and actually these two ends should coincide, but I submit that too often there are cases where need for excellence in the finished product is obscured in the student's mind by his craving for a good grade, which he knows he can get only by pleasing his teacher. Furthermore, classroom design and construction problems are necessarily pretty well cut and dried before being presented to the student, so that his interest may not be aroused to the extent possible were he the originator, or one of the originators, of the project. Moreover also, the thing may be irksome to him simply because it is something he must do. Doing what one must, rather than what one wants to do is necessary all through life, and may be conducive to strength of character, but a steady diet of it without any chance to exercise one's own initiative in creative work, will not go far in developing leadership.

The writer must here take the defensive long enough to state his position clearly. In the first place, he is not arguing against classroom work in design and construction. The thing a boy is supposed to come to college for is to learn by being taught. It is realized, also, that the engineering student will, upon graduation, take a subordinate position where he will have to work on problems outlined for him by his employer. It is true, furthermore, that all through life, whatever his position, he will be compelled to perform many tasks that are irksome to him and which seem to him to be of no account. It is also true that, of all the graduates of an engineer-

ing college, only a few will attain to positions of high leadership. The rest will always have to follow. A professor in a certain college was once quoted as saying, "We are not training men to be railroad employees; we are training them to be railroad presidents." If all engineering graduates—or even all the graduates of that institution—became railroad presidents and captains of industry, the demand for such would be somewhat oversupplied. And in college there will be some who are content merely to follow, and to do only the required work. A professor in an engineering college in the Southwest wrote recently, "Some men never do a stroke outside of required work, and we usually do not worry too much about such dull fellows,—there are enough of the other sort." It is with regard to that "other sort,"—the boys who have ideas of their own, and courage and industry enough to carry them out, that this paper is written. If their college cannot give them advice, encouragement, and facilities to carry out their ideas, it is unlikely that they will find these anywhere else.

To allay the suspicions of any who may fear that the writer is advocating an undue emphasis on shop work, it must be said that it is realized that the value of shop courses is often debated, and that some engineering schools have no shops at all. Certainly it is not the function of a university to turn out finished mechanics, and the main object of shop courses is, by familiarizing the student with shop operations, to enable him to design and to plan production with due regard to the possibilities and limitations of the shop. What he does advocate is that if an engineering student has an idea that he wants to work on, or if a group of them have such an idea, they should be able to find a sympathetic faculty, and if their wants are not too elaborate, they should be allowed to follow it up. A distinction may have to be drawn between the boy who simply wants to make trinkets such as bookends or other ornaments, and the one whose idea is a real engineering problem. It is to the latter that this paper refers. Sometimes such a problem may be undertaken as a thesis. Again, it may be too small for thesis credit, or possibly it may be something that the boy simply wants to carry far enough to try out. In either of the latter cases, if undertaken, it will probably have to be carried on outside the curriculum.

Advantages and Disadvantages of Extra-Curricular Engineering Projects

It is natural that there should be some objections to encouraging or even allowing students to carry on work of the kind referred to above.

Chief among these is an argument which is often cited against other forms of student activity; namely, that the participants may become so interested in the outside work that their studies will be neglected. This claim is perfectly legitimate, as human nature insists on being interested in all byways that lead aside from the path of duty. It is much nicer to work on one's own ideas than to prepare a lesson in mechanics, thermodynamics, or some other fundamental science. Nevertheless, this tendency to pursue some fancy to the detriment of one's class work is controlled in the case of other forms of activity, such as athletics, and it seems reasonable to conclude that proper control can be exercised over extra-curricular engineering projects as well. Indeed, it is doubtful if a student would be as likely to be led astray by a project related to his chosen work, as by social activities or some other less-serious campus goings-on. In the first place, probably only the more serious-minded students would have initiative enough to want to start any work of their own, and in the second place, the authorities can hold up such a privilege as a reward for those whose class work has been and continues to be above a certain grade.

Other arguments advanced against such work are that the students may lose interest and not complete their project, and that such projects are rarely small enough to be completed by any one group. These possibilities make necessary, first, careful faculty guidance in the choice of a project, and second, that the student or group be made to understand that they must not start such work without the determination to finish it. It is recognized that these conditions, particularly the latter one, may not be so easy to fulfill.

Considerations of safety in such work undoubtedly call for careful faculty supervision except possibly in the case of one or two of the most advanced and trustworthy students, and may necessitate limiting the number of students working independently at any one time. Another fact which calls for a sympathetic faculty is that students are seldom advanced mechanics, nor are they usually capable of carrying out a design without faculty suggestions and assistance.

There appear, however, to be a number of advantages in favor of such work when the aforementioned difficulties can be surmounted. Some of these have already been presented as favorable arguments and will only be mentioned here without comment.

It almost goes without saying that such projects give a student additional training in design and construction over what he gets in the regular courses. Working on his own initiative must also tend to stimulate his imagination and creative ability, and to develop his initiative. It must give him a definite incentive, and

therein is different from class work, as the ultimate object becomes the finished product rather than pleasing the instructor. It teaches coördination, as each man knows that the part he is designing or making must fit into the finished structure, and perform its function there. Other favorable arguments are those which apply also to Engineers' Day Activities, which are looked on sympathetically by many institutions, in spite of their interference with class work. These, as stated by a professor at one of the southwestern schools, are that such work teaches the student coöperation, the handling of men, working against time, and is a fine advertisement of the school.

Results of a Survey of Engineering Colleges

Recently, in an attempt to shed some light on a debatable matter, a survey was undertaken by the writer in which letters were sent to the deans of engineering in sixty-eight American colleges and universities, asking for a statement of the official attitude of each institution regarding extra-curricular engineering projects, and for an expression of opinion from each dean as to the advisability of encouraging or allowing students to carry on such work. The three institutions represented at this meeting were purposely not included in this survey, as their attitudes will, no doubt, be stated in the oral discussions. To date, fifty replies have been received to these inquiries. Twenty of these expressed themselves as being in favor of work such as outlined above, sixteen advised caution, ten were not favorable, and four were irrelevant. It was found impossible to classify any of the groups as to either geographical location or size of school. For instance, in the favorable group there are large schools and small ones; schools in the East, Middle West, and far West; old schools and new ones. The same is true of the other groups. The attitude of each seems to be simply the result of its own experience and the opinions of its faculty. It may be mentioned here that six of the favorable group and six of the cautious ones reported that groups of their students had built or were building gliders or airplanes.

Possibility of the student's tendency to neglect his studies for the outside work was mentioned by ten out of the sixteen cautious ones, and by six of the ten who were unfavorable. Other reasons advanced by these two groups have already been mentioned; namely, the question of safety, possibility of the students' losing interest, improbability of students being able to carry through either design or construction without faculty assistance, and the fact that it is very easy to choose a project so large that it cannot be finished by any one group.

Most of the arguments in the "yes" group have also been mentioned. A few others will be quoted. The dean of a large school in the far West writes, "I look upon this type of work as a means of instruction and not as a means of developing skill. . . . I am quite sure that the enthusiasm which is exhibited leads the student to do a great deal more, as a usual thing, than that for which he gets credit." The dean of engineering in another large western school writes, "My view is that this is the most valuable form of student activity." From a middle-western school in which 1100 are enrolled in mechanical engineering alone, "I have known of cases where the encouragement of projects such as indicated above has resulted in lowering standards, but in general I believe that the good from such projects more than makes up for the dangers which may result. . . . In general, every encouragement is given at this institution to students who are interested in using their own initiative."

Experiences at the University of Arkansas

In the spring of 1929, members of the A. S. M. E. student branch at the University of Arkansas wished to undertake, as a group, the making of some sort of an airplane engine. The Mechanical Engineering Department felt that such a project might stimulate considerable interest among all the M. E. students, as well as be of benefit to those taking part, and so sanctioned the idea. The engine was designed partly by the students and partly by the writer of this article. It is unnecessary to state the details of the engine, except that it is of the radial type, has five cylinders, and is air-colled. It was designed so that all parts could be made in the University shops except the pistons with their rings and pins, valves and valve springs.

The Mechanical Engineering Department has allowed use of the shops for this work. Supervision has been by members of the department and by the writer of this paper. Night work has been held down to one night per week, from seven to ten o'clock. Attendance at the night sessions has averaged about six. A few of the boys have put in spare hours in the daytime or drawings, patterns, and machine work. The design was finished some time ago, and all drawings have been traced and printed. The crankshaft has been finished. It was cut from a piece of 8-inch shafting 44 inches long, and is made in two parts, fastened together at the crankpin in a tapered and keyed point. All the connecting rods also have been finished and assembled. These were cut from solid pieces of steel—the master rod from a piece of 6-inch shaft. Several smaller parts, patterns and castings, have been completed.

Patterns for the cylinder head and cylinder barrel have also been finished. One of the boys has, with the help of a few suggestions, designed a machine to grind the cams, and has made the master cams and completed the machine. This job is an exceedingly creditable piece of work.

I confess frankly that a project as ambitious as the one outlined above is too large. The boys would probably have taken more interest if one group could have finished the job, or if those who were juniors at the start could have seen the completed machine before graduation. Still, the work is probably going on as fast as could be expected under the circumstances. There have been no accidents, no tools lost or broken, and members of the teaching staff do not notice that any of those taking part have fallen down in their class work.

On the other hand, several of the boys have expressed themselves as feeling that they had learned a great deal from the work that they did not get in class. The Fall after this work was undertaken, two senior M. E. students registered for senior thesis, which is an elective at this institution, and selected as their problem, one having to do with internal combustion engines. At the same time, two students in electrical engineering registered for thesis work. It is my understanding that these were the first theses undertaken at this institution in several years. During the current session of 1930–31, there are two M. E. students and one in civil engineering doing thesis work.

Registration in the Engineering College of the University of Arkansas in the Fall semesters for the past three years has been as follows: 333 in 1928, 330 in 1929, and 293 in 1930. In the same years, membership in the A. S. M. E. student branch of the same institution has been 14, 22, and 28 members. In other words, while the registration in engineering has decreased 12 per cent, student membership in the A. S. M. E. has doubled. It would be unwise indeed to claim that the increased interest in thesis work and in mechanical engineering is in any way due to our airplane engine project, but in view of the admitted debatability of the whole question, I cannot refrain from presenting these figures for whatever they may be worth.

Summary

In this paper the attempt has been made to show that:

1. All students are very likely to have some spare time on their hands, which those with any initiative will use in pursuing outside activities of one sort or another.
2. Many engineering students have a desire to design or make

pieces of machinery, or have ideas of their own as to possible improvements in existing machines, or wish to get certain information by experiment.

3. Proper encouragement by a sympathetic faculty in carrying out their ideas may increase their interest to such an extent that they will use time otherwise wasted or put into non-essentials, to work out their ideas on the drawing board and in the shop and laboratory.

4. Such encouragement and allowing them to undertake outside projects has some dangers, principal of which is that they may tend to neglect their studies.

5. This tendency to neglect studies can be controlled by proper faculty supervision, and the student's engagement in some engineering project on his own initiative is likely to develop his creative ability and to increase his interest in his chosen work.

6. Such a project has, on the whole, been successful at the University of Arkansas.

DISCUSSION

By W. H. CARLSON

Professor of Mechanical Engineering, University of Oklahoma

In discussing this paper I will refer to the conclusions:

1. Students are very likely to have some spare time on their hands which with any initiative they will use in pursuing outside activities of one sort or another. It is very true that all students have spare time on their hands. Oftentimes the poor student thinks he has more spare time than the better student actually has, so if students are permitted to work on projects of any kind, one should be very careful in selecting the students who can give the time without affecting their studies.

2. Many Engineering students have a desire to design or to make pieces of machinery or have ideas of their own as to possible improvements in existing machines or wish to get certain information by experiment. This statement is very true and is general for most students taking Engineering.

3. Proper encouragement by sympathetic faculty in carrying out their ideas may increase their interest to such an extent that they will use time otherwise wasted or put into non-essentials to working out their ideas on the drawing board or shop or laboratory. If a student has an idea that he wants to carry out in the shop or laboratory he does not need much encouragement, for if given access to the shops or laboratories he will immediately attempt to carry out his ideas.

4. Such encouragement, as allowing them to take outside projects, has some danger, principally that they may tend to neglect their studies. My experience has been that the time actually spent in the shop or laboratory would hardly be sufficient to cause a student to neglect his studies, but it is the time he spends in thinking of improvements on his project when he should be studying thermodynamics, electrical engineering, etc., where the greatest amount of time is consumed.

5. This tendency to neglect studies can be controlled by proper supervision by faculty and the student's engagement in some engineering project on his own initiative is likely to develop his creative ability and to increase his interest in his chosen work. We speak of proper faculty supervision. In the first place if there are one hundred or more students enrolled in a school and with the present teaching load that the faculty must carry along with other duties, it is impossible to give many students the time that would be required on a project in the shops or laboratories. It is often argued that if too much shop work is given to a student he will only become a glorified mechanic. This may be true, but I do not believe that there are any colleges of engineering that give sufficient shop work to develop a man's skill to a point where he could be classed as an expert. I am wondering, however, if there are not other methods of arousing the personal initiative of students in addition to shop work and laboratory work, such as permitting him to spend considerable time in the library gathering information for a thesis on the subject that he is most interested in, laying special emphasis on articles in the recent technical journals. By doing this the student would feel that he was being brought up to date and, too, he would become accustomed to working through the mathematical analysis of various problems made in the field. It is common knowledge that very few engineers in practice take the time to work through the mathematics of most articles after graduation either from lack of time or confidence, or ability to understand them should they take the time. If a student was capable of working these out while in school he would feel confident of his ability to work and understand them after leaving, which would be of value to him.

MINNESOTA BRANCH S. P. E. E. MINUTES OF THE FIRST 1931 MEETING

President Geo. C. Priester, Professor of Materials of Engineering, presiding.

The first meeting of the Minnesota Chapter of the Society for the Promotion of Engineering Education for the year 1931 was held Thursday, March 5.

Dinner was served at 6:30 P.M. at the Campus Club.

The question under discussion was "Training our graduates to meet the demands of the past, present, and future engineering problems." The subject was presented by Professor J. M. Bryant, Professor and Head of the Department of Electrical Engineering, and Professor C. A. Mann, Chief of the Division of Chemical Engineering.

After the Secretary read a discussion prepared by Professor F. W. Springer of the Department of Electrical Engineering, the heads of the degree-giving departments continued the discussion of this interesting and practical problem, in the following order:

Prof. J. R. DuPriest, Mechanical Engineering Department.
Prof. Frederic Bass, Civil Engineering Department.
Prof. John Akerman, Aeronautical Engineering Department.
Prof. F. M. Mann, Architectural Department.

Prof. Andrew Boss, Agricultural Engineering Department, ended the discussion by making a summary.

Meeting adjourned at 9:45 P.M., Central Standard Time.

CHAS. F. SHOOP,
Secretary.

DISCUSSION OF "TRAINING OUR GRADUATES TO MEET THE DEMANDS OF—FUTURE ENGINEERING PROBLEMS"

By F. R. SPRINGER

Professor of Electrical Engineering

It is obvious that only those graduates who both *can* and *will* are likely to have very much to do with the solution of the future problems. For this reason it would seem profitable to all concerned to use a system of college training which would limit its graduates to the *can* and *will* type. Other schools and places take care of those who cannot or will not.

College diplomas cannot take the place of fitness, will-power and training but diplomas should be a measure of *all* such characteristics. A successful system of college training should at least offer no advantage to dishonesty, parasiting, short-time memory or to mere cleverness, but *diplomas should give distinct recognition* to *judgment, courage* and *will power* as well as to *knowledge* and skill, because such characteristics are essential to success.

In order to put ourselves in a properly humbled state of mind it might help us to make an inventory of the graduates with whom we have had personal contact, following their respective changes in positions of success and failure over periods of 5, 10, 15 and 25 years, and then honestly considering how much the last problem of the last course had to do with their respective successes or failures. We would undoubtedly reach the conclusion that the causes generally laid much deeper than any course we may have offered. While the engineering student can be identified by the inevitable slide rule, only a comparatively few of our older successful graduates seem to have such devices handy. Our older banker friends seem to have little connection with ledgers and cash registers. One is compelled to wonder just what particular hereditary traits, information and training in college really are fundamental to success and what we are doing about it.

It seems to be generally agreed by both teachers and employers that "fundamentals" constitute the real essentials. Possibly the following:

1. A knowledge of the physical theory, equal to the feeling and knowledge of a trained musician for the performance of a musical instrument.

2. Ability to express conventionally such physical theory by words, diagrams, mathematics, etc., as may be desired by the individual or as required by circumstances.

3. Ability to apply such theory in competition.

4. Ability to move among people with a minimum of friction, requiring a training in the conventions and principles of society and of business and a suitable personality.

With these fundamentals, students are likely to succeed, but does our system select, train and recognize the essential qualities that make the above fundamentals possible—*i.e., judgment, courage, will power* and *knowledge* and *skill?*

It is true, of course, that different students can and will do, very satisfactorily, quite different types of work. Also, each branch of engineering has places for many kinds of real knowledge and skill, and *all* branches offer opportunities for the exercise of judgment, courage and will-power. It follows that it is not fair to limit graduates, in any field of engineering, to a *narrow* required course.

When one considers the range of talent from Faraday and Edison to Maxwell and Heaviside, it is evident that much care should be exercised in selecting a basis of elimination of the unfit. It would be just as unwise to dismiss the Faradays as to hamper the Maxwells. Colleges of Engineering should not be impossible places for geniuses. Hence, courses should be so arranged, for the good of the State, so that all kinds of the fit shall have their chance. This, to some extent, begs the whole curriculum question but, at the same time, emphasizes the idea that the value of judgment, courage and will-power should be measured by a diploma as well as knowledge and skill, and memorized prescribed information.

Our present American paternalistic (or maternalistic) system of education seems to go too far in trying to machine-make big ones out of all little ones who apply. Much of the *"can"* is supplied the students in solving assigned problems and many administrative rules and direct pressure bolster up weak *"will."* Our system is like that of a rich father who deprives his son of those conditions which make the father successful.

We are probably drifting slowly towards a modified continental system of training which does not pretend to make any graduates successful, as future leaders, except those who *can* and *will.*

Without going into many important details, let us imagine a system, applied, possibly in the junior and senior years, in which students might attend lectures and recitations, take quizzes and solve problems and even receive informal grades from their instructors but who would not be *compelled* to attend classes, and whose graduation would depend upon passing comprehensive examinations by committees, at the end of one year or of two years.

Naturally, such a system would eliminate almost all except those who both *could* and *would*. Others would not likely even come up for the finals.

Further, imagine the position of the teacher upon finding few students attending his classes and possibly learning that they were getting instruction in some other place and way, if they so desired.

Such a system would cause revolutionary changes for administrators, teachers and students, and personal responsibility would be greatly increased, with the results already mentioned.

Training students to meet the future demands in our country, already characterized as having the greatest wealth, the most expensive education and the greatest amount of crime, is certainly not a trivial matter and some means must be found such that only those who really can and will solve the future problems shall be rewarded, and that "success," even in acquiring a diploma, shall go to no other kind of graduate.

Are American engineering teachers afraid of such a system?

P.S. March 22, 1931.

One of the first of the "important details" referred to above in connection with the consideration of the adoption of a "modified continental system" for undergraduate engineering courses, would be the question of a proper foundation. Engineering teachers generally have little faith in the idea that merely exposing students to four years of high school, or college environment, would likely result in their catching even a diploma's worth of real knowledge and skill. Further, it is not probable that very many teachers would favor the adoption of a modified continental system even in the junior and senior years, without a substantial improvement in the fundamental training during the freshman and sophomore years, which in turn rests upon the high school.

Students entering a College of Engineering on high school diplomas are bound to represent a very wide range in inherent ability and fitness, and in preparation, both as to subjects and to kind of instruction received in the high school. There can never be any doubt about this condition.

Rigid entrance examinations might solve the problem if they were politically possible in State institutions, but few would care to face the upheaval which would result if such a method of selecting candidates were adopted at present. Besides, it would be futile, in many cases, to send students back to their respective high schools where the required subjects may not be taught at all or not taught very well for the purpose.

Another method would be to register high school graduates having diplomas, as now, and then to give all of them "*placement*" examinations, lasting one or several weeks, as to natural fitness, training and subject preparation. This would voluntarily eliminate quite a few students. Others could be given a ("sub-freshman") defeminized engineering college preparatory training. Of these, some would be able to graduate in four years by taking summer school work.

An increasing number of students, especially from certain high schools, would be found prepared to enter the regular engineering freshman courses. This is really the key to progress.

In conclusion, it does not seem probable that a modified continental system will be very seriously considered until the entrance requirement situation is on a different basis than at present. High schools have other things to worry about, which raises the question—

What are engineering teachers going to do about it?

F. W. S.

PROFESSIONAL ETHICS AND PRACTICES IN ENGINEERING*

By ANSON MARSTON

Dean of Engineering, Director of the Engineering Experiment Station, Iowa State College

The professional organization of engineering has matured very rapidly since 1900. A large and increasing proportion of the work of our great national engineering societies is now devoted to the professional as distinguished from the technical activities of our profession. Our state governments, with engineering license laws administered by boards of engineering examiners, and our engineering societies, with formal codes of engineering ethics administered by standing committees on professional conduct, are exercising more and more definite authority over the competency, the ethics and the professional practices of individual engineers. It has become the duty of our engineering colleges to educate their engineering students before graduation in professional ethics and professional practices.

Engineering a True Profession

Engineering is the profession most characteristic of modern civilization, and its recognition as such is now widespread. Engineering is at once the oldest and the youngest of the great professions: The oldest, because the invention and the use of tools and other mechanical devices was the most essential characteristic of the rudest beginnings of civilization; the youngest, because in former times mechanic arts and artisans were held in contempt and only in comparatively recent times has engineering achieved recognition as a true profession.

A *profession* is a life calling of such character that its practice is and should be confined to an organized body of men who, by reason of thorough educational training of advanced character and by extensive responsible experience, have attained high scientific and technical qualifications for their special work and from whose ranks the unfit and the unworthy are rigidly excluded.

The *origin* of the term profession is the fact that the members of a profession "profess" that they have the high qualifications needed to practice in their professed calling.

* An address delivered at the Civil Engineering Session of the Summer School for Engineering Teachers, Yale University, July 2, 1930.

The origin of the words, "engineering" and "engineer" is such as to indicate that the engineer should be thought of as primarily a man of genius, or possessing ingenuity, and that engineering should not be considered as merely an art.

The words * "engineering" and "engineer" come from the Sanskrit *jan*, to be born, from which the Greek form *gen*, and the Latin, *gen*.

"The direct line of derivation (of the word, engineer) may be traced to ingenium—natural capacity, talent, capacity for invention—and is closely linked with the words *genius* and *ingenuity*." †

The name "engineer" came to us from the Latin through the French noun *ingenieur*.

It is a mistake to think that the name of our profession is derived from the word *engine* or that the engineer is primarily concerned with engines. An engineer is an ingenious man, a man of genius. An engine is an ingenious machine.

Some of the professional characteristics of engineering are repeated here from the writer's lecture of yesterday (July 1, 1930,—"The Aims and Purposes of Civil Engineering Education").

Professional Characteristics of Engineering

1. A great system of engineering education.
2. Increasingly widespread requirement of governmental professional licenses to practice engineering.
3. A great professional engineering literature.
4. Many local and several great national professional engineering societies in each great country.
5. Increasingly strict formal codes of engineering ethics, more and more punctiously enforced.

Engineers' License Laws

Twenty-five states of our country have already adopted engineers' license laws, and thinking engineers now generally agree that such laws will in the future be universal in our country. Already some of the first laws passed have been revised, and it may be anticipated confidently that they will continue to improve and to become more stringent. Present engineers' license laws leave much to be desired in the qualifications which they lay down for practice, and their effective and equitable enforcement is still imperfect.

* *Life of Sir William Fairbairn*, by Dr. William Pole (Abridged), Minutes of Proceedings, Inst. C. E., Vol. CLXXIX, 1909–10.

† *Bulletin No. 16 of the Investigation of Engineering Education*, Society for the Promotion of Engineering Education, 1929.

Undoubtedly both their requirements and their enforcement will improve materially with time.

One weakness of present engineers' license laws is the "grandfather clause," entitling engineers already practicing in their state before the passage of its license law to receive licenses without any final examination. This, however, is a temporary situation merely. The "grandfathers" are dying off rapidly. Another weakness is the present extensive exemption of large classes of salaried engineers.

The state agency for the administration of its engineers' license law is universally at present a state board of engineering examiners, of many of which one or more engineering professors are members.

Twenty of the existing state boards of engineering examiners have united in a "National Council of State Boards of Engineering Examiners," which has already made noteworthy accomplishment in unifying practice, raising the standard of qualifications required of licensed engineers, and establishing an official system of reciprocity between the states. Practicing licensed engineers meeting a formal higher standard of qualifications, about equal to the requirements of the American Society of Civil Engineers for associate members, can secure from their own state boards "reciprocity certificates" which are recognized in the other states in the association for licensing without formal examination.

Engineers' license laws interfere materially with the work of many of our older, well established engineers, especially in the case of those who practice in several states, and probably the majority of older engineers would still at present personally prefer freedom from licenses. Our older engineers recognize, however, that the engineers' license law movement is bound to extend throughout the country, and for this reason our great national engineering societies are coming to coöperate in the shaping of new and the improvement of existing license laws.

The American Society of Civil Engineers now has a standing committee on engineers' license laws and plans a license law committee in every state of resident members of the society, the central committee to head the whole organization.

Already the society's standing committee on engineers' license laws has conferred with the National Council of State Boards of Engineering Examiners and upon request has taken the lead in framing a suggested uniform engineers' license law, which, after revision by representatives of the founder societies and the council of examining boards, has been published in pamphlet form by the American Society of Civil Engineers. The great advantages of uniformity in our state engineers' license laws are manifest.

It seems certain that the continued development and stricter enforcement of engineers' license laws will have an important effect upon engineering education. The outcome may be practically to exclude non-graduates of engineering colleges from engineering practice and to establish accredited lists of engineering colleges in every state, each of which colleges must meet standard qualification requirements set by state authority. In effect, accredited engineering colleges will then be in some degree official state educational agencies, whether or not state supported.

The vital relation of engineering to the great mechanic arts industries of the several states amply justifies official cognizance and official recognition of the standards and other qualifications of accredited engineering colleges.

Outline of the History of Professional Codes of Ethics

For untold ages theology, medicine and law were recognized as the only "learned professions," each an exclusive calling, confined to an organized body of learned men who "professed" to have high, special, learned qualifications and who vowed devotion to high ideals in their calling.

In theology the vows of the ministry are to God and have never been reduced to set form accepted by rival sects.

In medicine, the oath of Hippocrates dates back to 400 years before the Christian era. Strict medical codes of ethics have long prevailed. The code of medical ethics of the American Medical Association is formulated in detail and is enforced by numerous state and county medical societies as well as by the national organization.

In law, the oath of admission to the bar requires each law novitiate to vow devotion to high ideals of legal practice. The Canons of Professional Ethics and the Canons of Judicial Ethics of the American Bar Association are accepted in America as our legal codes of ethics, which all lawyers are obligated to obey and all bars and courts are obligated to enforce.

Engineering has now won recognition as a "learned profession," and teaching is striving for professional recognition.

The profession of teaching has not yet adopted any general code of teaching ethics, though such codes have been studied and to some extent formulated by authors * and committees of teachers' associations.†

In ancient times, architecture and engineering were united in one profession, and they still are very closely related and associ-

* *Teaching Profession and Practice*, A. R. Brubacher, The Century Co., N. Y., 1927.

† Pp. 290–295 of Brubacher.

ated. The Roman Architect-Engineer Vitruvius, first century B.C., included chapters on water supply, military engines and machines in his book on architecture, and gave a description of leveling instruments. The ideals of Roman architect-engineers may be judged by his words.*

> "Moral philosophy will teach the architect to be above meanness in his dealings, and to avoid arrogance; and will make him just, compliant and faithful to his employer; and, what is of the highest importance, it will prevent avarice gaining an ascendency over him; for he should not be occupied with the thoughts of filling his coffers, nor with the desire of grasping everything in the shape of gain, but, by the gravity of his manners, and a good character, should be careful to preserve his dignity."

Another Roman surveyor, engineer, soldier and public official was Frontinus, who wrote a treatise† on the water supply of Rome at about A.D. 100. Frontinus was *Curator Aquarum* (Director of Water Supply) under the reform administration of Emperor Nerva Augustus and his book shows that he held high ideals of service. He says:

> "* * * and inasmuch as I am moved not only to devote diligency, but even love to any matter confided to my care, be it on account of inborn zeal, or by reason of faithfulness in office; and inasmuch as Nerva Augustus, * * * has now conferred upon me the duties of water commissioner (of water works superintendent, curator aquarum), duties contributing partly to the convenience, partly to the health, even to the safety of the city, and from olden time exercised by the most distinguished citizens; I therefore consider it to be the first and most important thing to be done, as has always been one of my fundamental principles in other affairs, to learn thoroughly what it is that I have undertaken.
>
> "There is indeed no better foundation for any business; nor can it in any other way be determined what is to be done, and what omitted; nor is there for a fair-minded man so debasing a course as to perform the duties of an office intrusted to him according to the directions of assistants: a course, however, which must be followed, whenever an inexperienced official takes refuge in the practical knowledge of his assistants; whose services though necessary for rendering help should nevertheless be only a sort of hand and tool of the principal in charge."

Francis Bacon, A.D. 1561–1626, though not an engineer, was so eminent and so potent an agent in advancing that deductive sci-

* See translation by Joseph Gwilt; an English architect, 1874.
† See translation by Clemens Herschel, Boston, 1899.

ence based on experimental research which is so characteristic of engineering that his ideals of professional obligations are of special interest. Says Bacon:

> "I hold every man a debtor to his profession; from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereto."

The code of ethics of the American Institute of Architects is in force in the United States, and antedates all other engineering codes of ethics.

Engineering codes of ethics have been adopted by a number of great national engineering societies, apparently the first of which in America was the Canadian Society of Civil Engineers (now the Engineering Institute of Canada), in 1896. This code was revised in 1914.

The American Institute of Consulting Engineers, Inc., adopted a code of ethics in 1911.

The American Society of Civil Engineers adopted a code of ethics in 1914, which has since been expanded and supplemented by a code of professional practice, adopted in 1927.

The American Society of Mechanical Engineers adopted a code of professional practice in 1914.

The American Institute of Electrical Engineers adopted a code of principles of professional conduct in 1914.

The Western Society of Engineers adopted in 1917 a "code of ethics" which is in reality a statement of the general principles on which a formal code ought to be based.

The American Association of Engineers adopted in 1919 a code of ethics, and in the interests of uniformity has adopted the code of practice of the American Society of Civil Engineers.

There has been some discussion of the desirability of a single engineering code of ethics or practice, adopted by all the great national engineering societies; such a universal engineering code is a possibility of the future.

Professional Ethics and Professional Honor

There is a distinction between professional ethics and professional honor. The professional obligations of engineers include both.

The word *ethics* is derived from the Greek *ethos*,—character.

> "*Ethics* is the science of the ideal human character." *
> *Honor* means "fame, credit, good name, reputation." *
> "Honor thus carried with it the notion of social obligation, and in societies having a caste organization, as in feudal so-

* *Webster's Dictionary*, 1889 edition.

cieties, it often implies primarily a strict observance of caste obligations, and in particular of the obligation not to bring discredit upon persons of the same caste." *

The artificial code of honor of feudal days is worn out and discarded, but engineers are under obligation to cherish an equally intense and more fine sense of chivalric honor, forbidding their bringing discredit upon their profession, and calling for personal sacrifice to whatever extent required in rendering high engineering service to their clients and to the public.

> "Say, what is honor? 'Tis the finest sense
> Of justice which the human mind can frame,
> Intent each lurking frailty to disclaim,
> And guard the way of life from all offense
> Suffered or done." †

The Principles of Professional Ethics

A careful study of the codes of engineering ethics and practice will show that they are based upon the highest principles of honor and justice. They demand that every member of the profession of engineering shall constantly maintain

> "A nice sense of what is right, just and true; with a course of life corresponding thereto." ‡

The ethical obligations of the engineer fall mainly in six classes, as follows: §

1. *The obligations of the engineer to his client:* to whom he owes competent service, loyalty, honesty, courtesy and fairness.

2. *The obligations of the engineer to himself.* It is his duty to make the most of his ability and other qualifications; to demand respect and fair remuneration; to maintain health, virtue and justified self respect and self confidence; to gain friends, and keep them; a family, and guard and cherish it always.

3. *The obligations of the engineer to the public.* It is treason for the engineer to betray the public in any way. It is the duty of the engineer to be a good citizen as well as a good engineer, taking part in public affairs at all times, and interesting himself especially in all public questions of an engineering character.

4. *The obligations of the engineer to contractors,* to whom he owes strict justice and fairness.

5. *The obligations of the engineer to his fellow engineers.* The engineer must treat other engineers as professional brothers, main-

* *Webster's Dictionary,* 1889 edition.

† Wordsworth.

‡ *Webster's Dictionary,* 1889 edition.

§ *Engineering Ethics,* Anson Marston, Purdue Engineering Review, Vol. 19, No. 4, May, 1923.

taining in all his relations with them the fairest terms of courtesy and square dealing.

6. *The obligations of the engineer to his profession.* The engineer must subscribe to engineering journals; must join local, state and national engineering societies; must promote the advancement of engineering education; must bear himself as a loyal member of the great professional fraternity.

The Enforcement of Engineering Codes of Ethics and Practice

Codes of engineering ethics are of little value unless they are observed faithfully, in spirit as well as in letter, and by practically all members of the profession. Such observance may be voluntary or enforced.

Undoubtedly the vast majority of engineers voluntarily will observe engineering codes adopted formally by their national societies or established by tradition and custom. In every profession, however, there is always an unworthy minority, willing to injure the public and their professional brothers by stooping to unethical practices unless restrained by fear of retribution.

The enforcement of engineering codes of ethics should begin in the engineering college, by maintaining manly discipline and by educating engineering students in professional codes and practices.

Enforcement is continued when the engineer makes application for admission to that membership in local, state or national engineers' clubs and societies without which no present day engineer can hope to get far in his profession. Applications for admission to engineering societies are scrutinized with increasing strictness. The American Society of Civil Engineers publishes and distributes to its entire membership the detailed record of every candidate for admission or for promotion to higher grade, with request for information from every member as to any known reason for disbarment from entrance.

Young engineers should be forewarned while still in college that their college records and the opinions of their fellow engineers are sure to come to light in this future ordeal. If young engineers could realize how unworthy acts may reappear to daunt them long years after supposedly buried in the forgotten past no sacrifice would be thought too great, no extreme of care too scrupulous in guarding their engineering honor.

The engineering societies provide official methods for filing and receiving charges of professional misconduct by members and for expulsion or other disciplinary action if necessary.

The great national engineering societies and some others now maintain standing committees on professional conduct, specially

charged with the duty of investigating member infractions of the professional codes of ethics. Recommendations are made by the committees to the boards of direction of the societies as to what action should be taken in each case. The work of professional conduct committees is arduous. In their consideration of individual cases, precedents are rapidly being established, and we may soon expect special society publications presenting the official codes of ethics accompanied by a body of rulings and interpretations in typical individual cases.

Engineers' Fees and Salaries

The professional obligations of the engineer include his duty to demand respect for himself and fair remuneration for his services. These are due to himself, to his fellow engineers and to the engineering profession, which will be lowered in esteem and in quality of service if its services are cheapened. A large proportion of the charges against engineers of professional misconduct are caused by real or imagined cutting of prices below those maintained by self-respecting competitors. A large proportion of present-day engineers are employed on the salary basis by the public or by corporations. Engineers' salaries should be commensurate with the values of their services.

Engineering societies are now concerning themselves more than ever before with establishing scales of minimum engineering fees and salaries.

Such scales apply only to *minimum* fees and salaries. "* * * While all men and some engineers may have been created equal; the service of such engineers to their clients cannot by any possibility be considered to be equal." The value of the service of the outstanding engineer "frequently entitles him to greatly increased remuneration above that which can be considered in any scale of recommended fees for services of engineers as a body."*

The American Society of Civil Engineers has a standing committee on engineers' fees, and another on salaries. A tentative report by the committee on fees appears in *Proceedings* for September, 1929. A valuable paper by the chairman of the committee on engineers' salaries appears in *Proceedings* for March, 1930.

The American Association of Engineers published in 1929 a valuable pamphlet on "How to Employ and Use Services of Practicing Engineers," which contains recommendations for minimum engineering fees.

* *Report of Committee on Fees*, A. S. C. E., Sept. Proceedings, 1929.

Engineering Student Codes of Ethics

The writer has already indicated in this lecture his belief that engineering colleges ought systematically to educate their engineering students in professional ethics and practices. He now wishes to suggest that one effective means of accomplishing this purpose would be to encourage engineering students to formulate and adopt for themselves a "Code of Engineering Students' Ethics."

Engineering students should be treated like young men, not like adolescent boys. Their standards of ethics and honor might be much higher if based on formal codes developed and adopted by themselves. Practitioners representing the various engineering societies maintaining student chapters at the engineering colleges should assist in the development and self-enforcement of codes of engineering students' ethics.

The following is a quotation from an address on engineering ethics in 1923 by the writer to the engineering seniors of Purdue University:

> "The future of the engineering profession during the next half century depends upon you young men, just about to enter its ranks, rather than upon us older men, who find it so hard to change our attitude of mind as new questions arise in the onward progress of engineering.
>
> "I wish I could somehow make you really comprehend the overwhelming importance of engineering ethics to you.
>
> "Be honest. Honesty is absolutely fundamental in all professions, but especially so in engineering, where vast financial operations often are directed by members of the profession who have not been trained in financial guile. Cheating in college work is dishonesty. There is no room anywhere in the engineering profession for any man who has any dishonest streak anywhere in his soul.
>
> "Keep absolutely clean from all vices. The engineer must be of good repute among all men. Vice is a form of dishonesty, dishonesty to one's own soul. Vice undermines health. Success in engineering requires a strong, clean body as well as a strong clean mind. Vice enslaves. The engineer must be free.
>
> "Do your college work well. Honesty requires that no engineer shall undertake work for which he is not qualified. It is possible that sometimes you might succeed in cheating your engineering faculty, but you can never cheat engineering science. The laws are immutable and unbeatable.
>
> "Be true to yourselves. Every engineer owes it to himself to make the utmost possible out of himself.
>
> "Be true to your client. In undertaking work for him

you obligate yourself to render him true, faithful and competent service, and to guard his interests.

"Be true to the public and to your country. Be a good citizen as well as a good engineer. Vote at every election. Take a good citizen's part in politics. Render true and efficient public service, whenever called upon, and always take part in shaping wise public decisions on all engineering phases of public affairs.

"Be true to your obligations to the engineering profession. It is a fraternity in which you are to become a brother. Treat every engineer as a brother engineer, but place the interests of the profession above those of any man, even yourself.

"You owe to the profession, to yourself and even to your client (who otherwise will cheapen your advice) to charge for your services just what they really are worth. You should seek a competence, if only as a matter of self-respect and of the good repute of the engineering profession. Yet you should not be avaricious."

The Ethics of Engineering Faculties

The writer wishes to close this address with some general observations on the professional ethics of engineering professors and deans, realizing that he is venturing on dangerous ground.

First, on the ethics of their work in educating engineering students, both professors and deans have pressing obligations, more important than they often realize, to put their teaching and their other educational work on the highest plane of ability, professional attainment, scholarship, fairness, courtesy and sympathy. They should acquaint themselves with their individual students and constantly strive to teach and to inspire by precept and example, in and out of classes. After more than thirty-eight years of engineering college work, I am amazed and daunted by the reverence with which the average engineering alumnus regards his old professor. There is no proper place in engineering faculties for any man except those of highest fundamental manhood qualifications, added to professional engineering and teaching attainments of the highest order.

Second, on the ethics of their relations with each other and to their colleges, engineering professors and deans should hold to the same high ideals of professional brotherhood as are called for in codes of engineering ethics. Fairness and courtesy must be especially characteristic of engineering teachers. The dean should promote the professional advancement of every member of his faculty, even if he thereby loses good men, and he should try his best to secure adequate reward for all who render high service, yet he should have the courage to part company with slothful or in-

competent teachers. Administrative organization should be such as to place initiative and responsibility on every member of the faculty. Due academic freedom to teach and freedom to learn must be maintained in engineering colleges, yet the engineering faculty should be much more than a mere number of individuals, however able. A faculty cannot accomplish its best without effective coöperative effort.

There are many special relations between professors and other professors, professors and deans, professors and general college authorities, which might well be put into a somewhat formal statement of principles, worked out jointly, to the great advantage of higher education.

The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FREDERIC G. HIGBEE, EDITOR

At the Columbus meeting, June 19, 1929, Descriptive Geometry was defined by the Division of Engineering Drawing as: "The study of the theory of a universal means of expression; it is a grammar of the graphical language." The division further agreed that the purpose of this subject include the development of the power of visualizing objects, of analyzing objects into their geometrical elements, of determining the geometrical relations between the elements, and of representing these elements in drawings in their true geometrical relations.

It is claimed for Descriptive Geometry that this subject is the only one which teaches the student to visualize thoroughly, to represent accurately, and to *think* logically.

It is interesting to note the studies now being conducted by Dr. Clair V. Mann reveal the fact that engineers of the present day are of the opinion that the power to visualize is of great importance—well-nigh indispensable to engineers—and that the power is particularly indispensable to the type of engineer whose work is of a creative nature. The trait is not so necessary for the average engineer who may be engaged in routine work. These engineers believe that the power to visualize is capable of development, likewise that there are no tests which measure the quality. Opinions indicate that of college courses which develop the quality, descriptive geometry is outstanding, with mechanical drawing and machine design close seconds. Kinematics, graphic statics, and physics are assigned much less importance, and chemistry is rated as of small value in developing the trait.

Engineers on the whole are possessed of a high degree of imagination when it comes to the reading of books and in envisaging faces and features of persons not present. The form of visualization most common among engineers is quite clearly that type of visualization corresponding to vision with the eye. In order, after the type corresponding to vision, would be the types corresponding to feeling, sense of temperature, hearing, smelling, kinesthetics, and tasting. Since taste and smell are infrequently used in design work, these answers seem to indicate that the development of the power to visualize is a matter of training; at least that it is capable of very large modification through training and experience.

Dr. Mann's conclusion from the whole study of this opinion is that the power to visualize is a trait of such value in engineering that it is highly worthwhile to develop it in the engineering student. Before scientific answers can be given to the question as to whether any particular course or college training in general develops the trait, there must be constructed scientific tests which will measure the quality, not only in latent form but in the form of increments. The development of such tests is now under way in Dr. Mann's laboratory with promise of considerable success.

NEW MEMBERS

BOND, GEORGE W., Assistant Professor of Chemistry, South Dakota School of Mines, Rapid City, S. D. E. D. Dake, C. G. Watson.

BROWN, WILSON F., Associate Professor of Chemical Engineering, Kansas State College, Manhattan, Kansas. R. A. Seaton, A. J. Mack.

CONNER, N. WHITE, Assistant Professor of Applied Mechanics and Experimental Engineering, Virginia Polytechnic Institute, Blacksburg, Va. E. B. Norris, Louis O'Shaughnessy.

GAMBLE, WILLIAM H., Assistant Professor of Electrical Engineering, South Dakota State College, Brookings, S. D. H. M. Crothers, H. S. Carter.

GARLAND, CLYNE F., Assistant Professor of Mechanical Engineering, University of California, Berkeley, Calif. H. B. Langille, B. F. Raber.

HILL, ARTHUR M., Instructor in Mechanical Engineering, Tulane University, New Orleans, La. D. S. Anderson, W. B. Gregory.

KARSTEN, ANDREW, Professor of Chemistry, South Dakota School of Mines, Rapid City, S. D. C. G. Watson, E. D. Duke.

MERRILL, GEORGE A., Director, California School of Mechanic Arts, San Francisco, Calif. F. L. Bishop, Nell McKenry.

PECK, JOHN S., Assistant Engineer of Tests, Columbia University, New York City. J. C. Rathbun, A. H. Beyer.

PRICE, LEONARD C., Research Associate Professor of Mechanical Engineering, University of Arkansas, Fayetteville, Ark. W. N. Gladson, W. R. Spencer.

RAW, RUTH M., Instructor in English, University of Akron, Akron, Ohio. Sada A. Harbarger, Fred E. Ayer.

RICE, ROBERT B., Associate Professor of Mechanical Engineering, Newark College of Engineering, Newark, N. J. A. R. Cullimore, J. A. Brooks.

RICHMOND, ADDISON E., Instructor in Civil Engineering, Howard University, Washington, D. C. Darnley Howard, L. K. Dorning.

SCHEVE, CARL J., Instructor in Civil Engineering, University of Colorado, Boulder, Colo. C. L. Echel, H. J. Gilkey.

SHELDON, DAWSON C., Associate Professor of Mathematics, Clemson Agricultural College, Clemson College, S. C. D. H. Shenk, B. E. Fernow.

WALKING, WALTER, Instructor in Electrical Engineering, South Dakota School of Mines, Rapid City, S. D. E. E. Clark, C. G. Watson.

WALTON, GRAHAM, Instructor in Civil Engineering, South Dakota School of Mines, Rapid City, S. D. C. G. Watson, E. E. Clark.

A COMMUNICATION FROM THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Dear Mr. Bishop: You will doubtless be interested in the following resolution adopted by the Board of Direction at its meeting on January 19, 1931:

> "Adequate professional training in actual engineering practice is essential, in addition to university training, as part of the qualifications of engineering teachers, and is entitled to due recognition. While approving the continuing development now under way of graduate work in engineering leading to advanced degrees, including the Ph.D. degree, attempts by any college or university association to demand Ph.D degrees in general branches as part of the requirements for the engineering professors in accredited colleges is disapproved."

Yours very truly,

GEORGE T. SEABURY,
Secretary.

COLLEGE NOTES

Massachusetts Institute of Technology.—After a number of years of trial on a smaller scale, the comprehensive examination for senior honors students in the Department of Electrical Engineering has acquired increased status and enlarged opportunity for effectiveness and influence. By recent vote of the faculty the usual second term senior year examinations and quizzes have been entirely waived for these students in favor of a comprehensive examination, for which a two-week period has been set aside near the end of the year.

The comprehensive examination will be originated and administered by outside examiners invited from other educational institutions and from industry, in collaboration with deputed members of the Institute staff. It will search into the entire field of study of each honor student, not merely by means of a variety of isolated questions but largely by means of questions and problems in themselves more or less comprehensive. It is hoped that the comprehensive examination will serve not only as a measure of achievement for these students, but primarily as an influence upon their attitude toward study during the whole undergraduate period.

A six-weeks Textile Course for textile executives and research directors, begins February 13. This course will cover design of textile testing laboratories, conditioning apparatus, preparation of textile specimens, thread counting devices, cord testing machines, fabric testing machines, special tensile testing instruments, and instruments for measuring crimp, effect of corkscrew in plied yarns, and other special properties of fabrics. It also includes a series of lectures on textile microscopy.

Professor Wilhelm Blaschke, of the University of Hamburg, delivered a group of lectures during February on selected topics in "Differential Geometry," under the auspices of the mathematics department.

Another Rhodes Scholarship has been awarded to an Institute graduate, Mr. Morris Shaffer, who graduated last year from the Department of Biology and Public Health, and is at present an assistant on the instructive staff. Next autumn he will enter Oriel College, Oxford University, where under the provisions of the Rhodes Scholarship he will have the opportunity to study for three years.

McGill University.—A movement has been set on foot for the purpose of establishing a memorial to the late Dr. Henry Martyn MacKay, Professor of Civil Engineering from 1907, and Dean of the Faculty of Applied Science from 1923 until his death in October last. The Committee in charge of the matter, having in mind the brilliant scholarly attainments of Dean MacKay, and his keen appreciation of sound learning, have decided that a memorial in the form of scholarships open to undergraduates in the Faculty of Applied Science would be most appropriate. The members of the Faculty, many of whom have been intimately associated with the late Dean over a long period, have unanimously endorsed the proposal as eminently fitting.

The **University of the City of Toledo** opened its second semester in its beautiful buildings on West Bancroft Street, Tuesday, February 10. The buildings, the 114 acre campus and building equipment were provided out of the $2,850,000 bond issue voted by the citizens of Toledo.

The beautiful stone exteriors of both University Hall and the Field House give little indication of the immensity and completeness of the interiors.

University Hall is a 337-room building of Collegiate Gothic Architecture with a 200-foot tower. Included are 66 class rooms, 50 laboratories and shops, 4 lecture and conference rooms, 30 rooms devoted to preparation and supplies, 15 closets, 7 rest and social rooms, 4 rooms devoted to cafeterias and kitchens, 6 rooms for student activities, 7 rooms for library purposes. Many vaults, storage

rooms, closets and rooms for miscellaneous purposes have also been provided.

In one wing of the building five large chemistry laboratories are provided and private laboratories have been arranged for research and experimental work by faculty members. Laboratories have been provided for pharmacy, biology, histology, botany and zoology. One large science lecture room with a seating capacity for 250 is also provided. One of the novel features of this room is the rolling demonstration tables for the instructors. Back of a sliding blackboard at the front of the room is a preparation room where other instructors may set up their tables for succeeding lectures while one group is assembled. This allows for almost continuous use of the room.

In another wing of the building laboratories and class rooms are provided for all work in engineering, physics and astronomy. There is a lecture room with seating capacity for 100 and laboratories for hydraulics, machine shop, mechanical engineering, civil engineering, electrical engineering, materials testing, physics, astronomy, engineering drawing, machine design, blue print, model and storage rooms.

BOOK REVIEWS

Electrical Equipment. By T. C. Lloyd, of Ohio State University and Antioch College. Published by John Wiley & Sons. Price $3.50.

The problem of presenting modern power equipment, together with their costs and applications, has been solved very effectively by the author. This book is divided into eighteen chapters with a list of problems as an appendix covering the subject matter.

The book opens with a description of electrical systems in use today. Power plant circuits are covered including calculation of bus bar spacing, switching, circuit breakers and switching control. Typical switchboard diagrams are shown with illustrations for each type. Meters of all classes including ammeters, voltmeters, watt-hourmeters, demand and recording meters, are classified and dealt with at some length. Generators, both A.C. and D.C.; transformers, motors, batteries receive consideration as to construction, characteristics, choices of applications and like features. Cost curves are presented for the various machines which would be useful in practice.

The author has gone to considerable work in dealing with Illumination and Electric Heating. Tables are given for present stand-

ards for illumination of interiors; outdoor lighting as parking zones, boxing arenas, etc.; spacing of outlets; coefficient of utilization and other important items. Following the method used in other chapters of the book, Electric Heating is first classified. Specific problems are taken up for mass and space heating. Tables are presented for resistance heating. Different types of furnaces and their control are given.

The latter chapters of the book are devoted to Transmission and Distribution, Rectification of alternating currents, Protection, Power bills, Power factor and Engineering Economics. In the latter chapter, costs, interests, present worth, vestances, units costs are defined and practical solutions and formulas are included.

This book can be used with profit as a reference book for any one interested in this subject and as a textbook for a general course in Electrical Equipment.

R. W. A.

Electricity: A Study of First Principles. By ELMER E. BURNS, Instructor in Physics, Austin High School, Chicago. Published by D. Van Nostrand Company, Inc. 235 pages. Price $1.75.

This book contains twelve chapters treating the first principles of electricity from the physicists viewpoint with the application always in view. The appendix contains wire tables, physical properties of many of the materials used in electricity and conversion tables.

During and at the end of each chapter there are several problems designed to clinch the principles set forth in the text matter. At the end of each chapter there is a set of pertinent questions on the text.

The author demonstrates the principles set forth in each chapter by numerous examples mathematically worked out and also by numerous cuts and photographs.

This book should find its largest application with students in trade schools or students taking science in high schools. The chapters come in logical sequence from the point of view of the electrical engineer.

P. E. R.